Adapting and Testing the COAMPS/COBEL Low Cloud Nowcasting System for Winter Conditions

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LONG-TERM GOALS

An improved an automated, globally applicable, integrated ceiling forecast product in DAMPS that will give the on-scene meteorologist a new capability to provide useful environmental information tailored to the individual needs of Navy aircraft pilots.

OBJECTIVES

The NRL COAMPS (Coupled Ocean/Atmosphere Mesoscale Prediction System) regional ceiling product will be blended with the UQAM COBEL (Code Brouillard Eau Liquide) column modeling technology to produce more precise forecasts of ceiling height and the time of clearing of stratocumulus ceilings than are provided by either model separately. The value of this product to regional forecasters, the global applicability and skill of this technology will also be assessed.

APPROACH

The methodology will make use the strengths of both NRL's COAMPS and UQAM's COBEL model. The latter has the capability of performing very high resolution calculations of boundary layer processes in a column in the atmospheric boundary layer while COAMPS can provide detailed information of the characteristics of the air flowing into and above the column. Preliminary work using data in the region of Point Mugu has shown that that combining COBEL with advections calculated from the output from COAMPS (Christian Pagé at UQAM and John Cook at NRL) can make improvement in skill of the ceiling forecast of summer marine stratocumulus, compared to forecasts from COBEL or COAMPS alone. It remains to extend this capability to winter ceiling situations by extending the capabilities of COBEL to the cold season by adding (Wanda Szyrmer and Eva Monteiro at UQAM) winter cloud and precipitation parameterizations (ice, snow and supercooled water). Through a coordinated effort between NRL Monterey (John Cook), the National Center for Atmospheric Research (Wes Wilson) and the University of Quebec at Montreal (UQAM), a COAMPS-COBEL hybrid system will then be verified under appropriate winter conditions in the United States using cases for which the fine-scale COAMPS data are available. The skill of this site-specific ceiling product will be then evaluated in other winter and summer situations and enhanced based on lessons learned. The mature product will be given to operational forecasters at the Naval

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14. ABSTRACT

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15. SUBJECT TERMS

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Pacific METOC Center (NPMOC) San Diego for their evaluation of its utility, and to develop and evaluate an integrated ceiling product as a DAMPS option.

WORK COMPLETED

A more general all season microphysics parameterization available from MM5 (Fletcher 1962, Reisner et al 1998, Hallettand and Mossop 1974, Kessler 1959, Lin et al 1983, Meyers et al 1992, Pruppacher, and Klett, 1978, Rutledge and Hobbs 1984) has been implemented in the COBEL model at UQAM. This improved parameterization also required the implementation of a split-time first order upstream numerical scheme. The code has been validated for warm season marine stratocumulus, with and without drizzle, by comparing the results with previous COBEL simulations that used Kessler's (1959) parameterization (Figure 1). The recently implemented OSU soil model taken from the Oregon State University Model (Ek and Mahrt 1991) has also been validated for summer conditions along the US West Coast.

After a review of the 2000-2001 cold season by Nathalie Gauthier at UQAM, the stratocumulus in the Washington D.C. area on November 15, 2000 in was chosen as a test case (Figure 2). The morning sounding (Figure 3) suggests that this was a typical case of cold air outbreak stratocumulus that is capped by a subsidence inversion.

Three nested grids, centered on Washington D.C. were defined for running COAMPS for this test case and sample COAMPS "flat file" output have been received at UQAM.

IMPACT/APPLICATIONS

The hybrid COAMPS/COBEL forecasting system has the potential of being an important tool for improving the forecasts of boundary layer processes that have significant impact on Navy aviation operations such as the formation and dissipation of low clouds and fog.
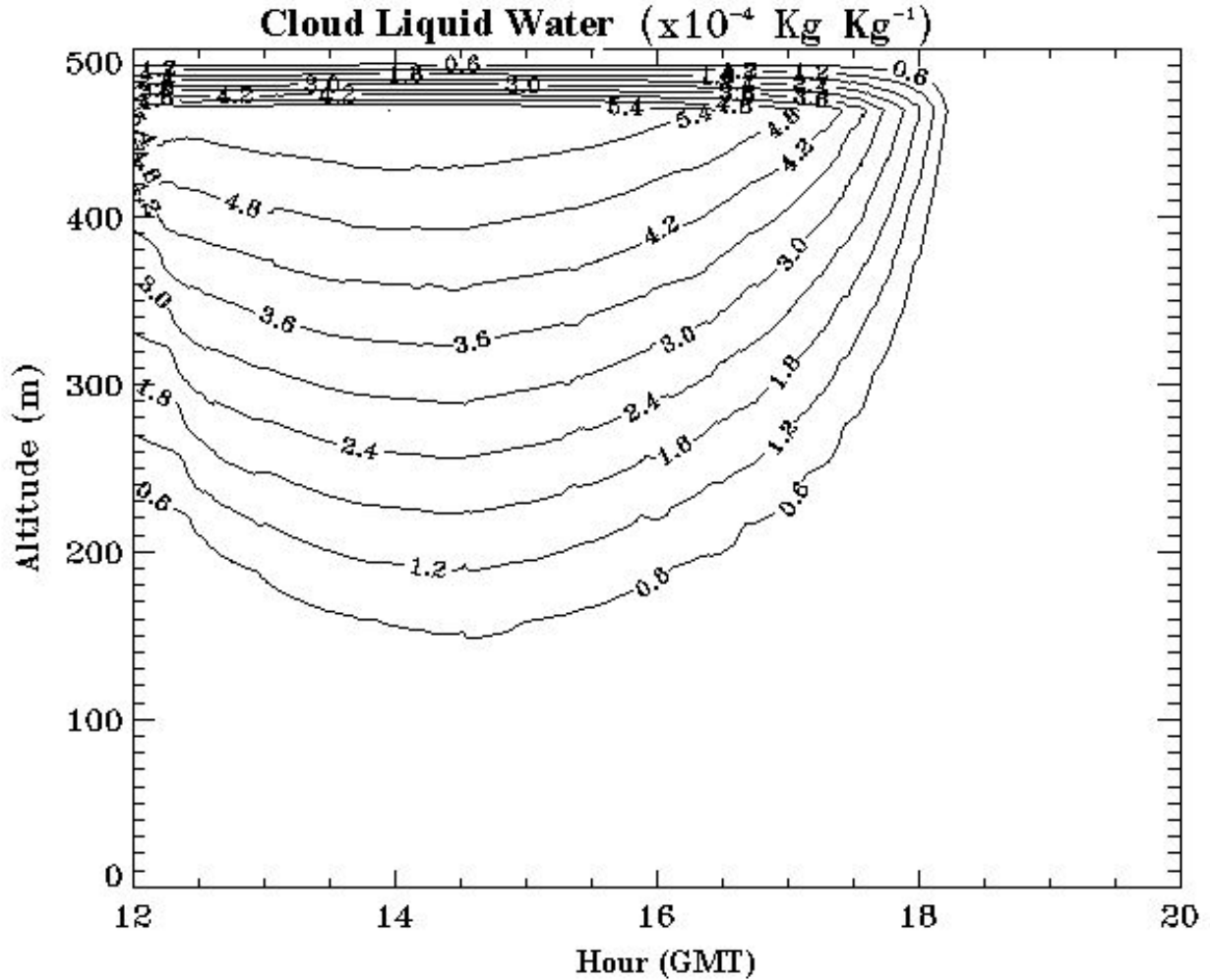
Figure 1. A height-time diagram showing the simulated evolution of liquid water mixing ratio in summer marine stratocumulus in the San Francisco Bay area using the MM5 microphysics. This simulation was initialized at 1200 GMT on August 12, 1997 with a cloud top just below 500 meters and cloud base near 200 meters. During the first 3 hours of the simulation the cloud base descends about 100 meters and then rises quickly until burnoff that occurs near 1800 GMT (within a half a hour of the observed burnoff). The maximum cloud liquid water mixing ratio, which is found just below cloud top, decreases almost linearly to zero at cloud base. This maximum remains nearly constant at approximately 5.5 x10-4 Kg/Kg until 1600 GMT and then decreases rapidly to zero at burnoff.
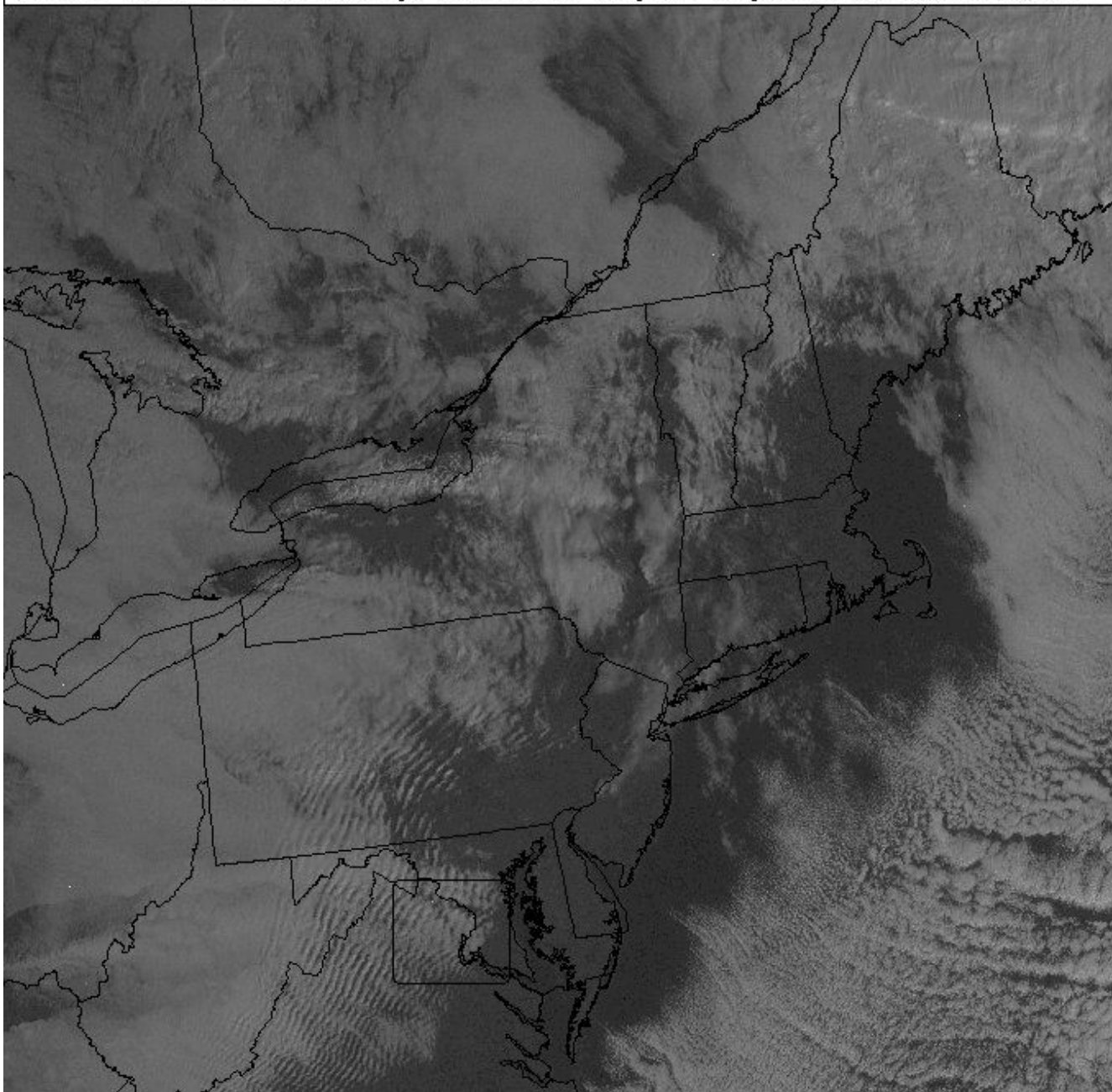
Figure 2. Visible satellite image in the Northeastern U.S. at 1402 GMT on November 15, 2000 showing clouds over much of the Middle Atlantic and Northern New England States and over the open waters of the Atlantic. A box outlines the stratocumulus clouds in the DC region.
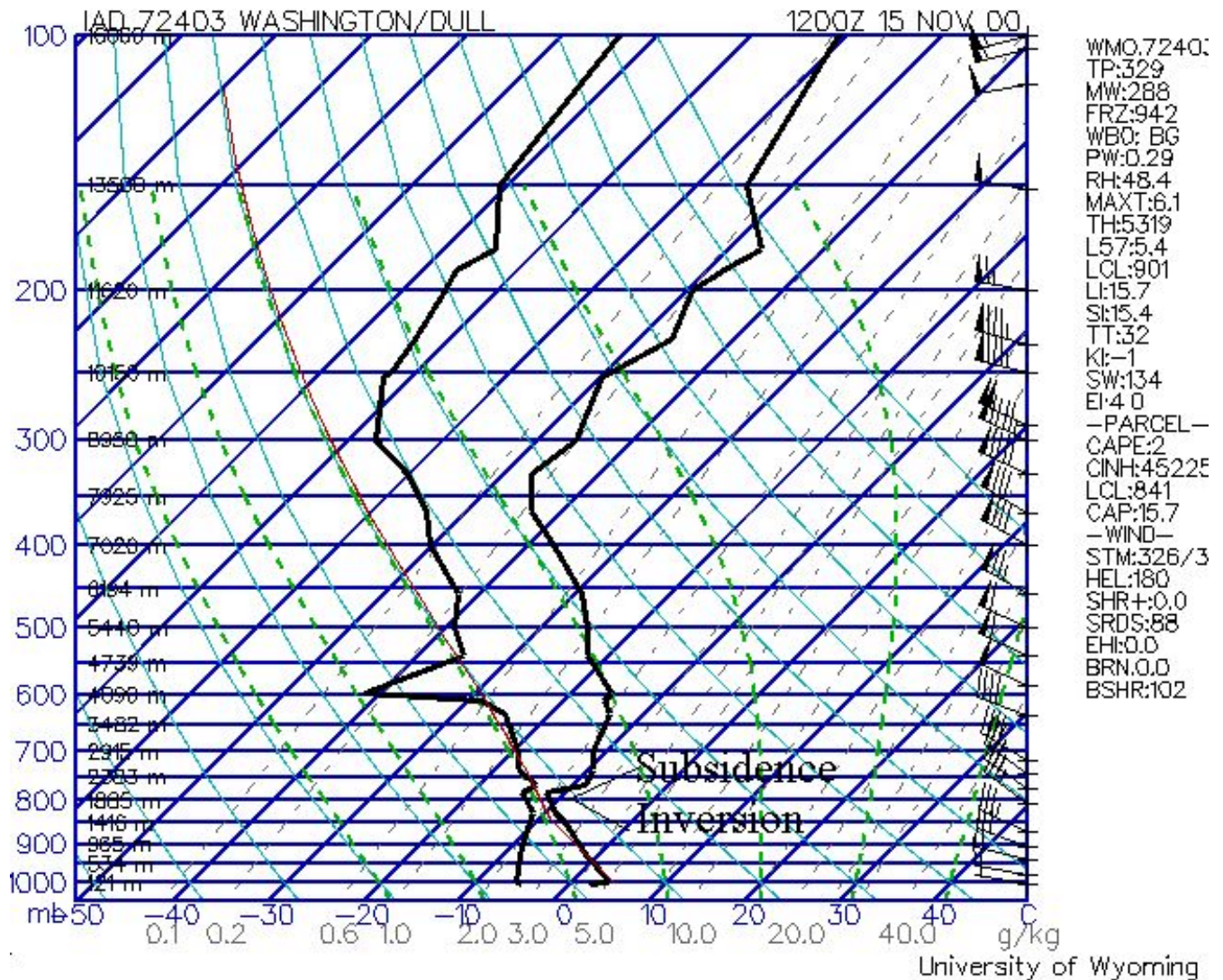
Figure 3. Sounding of temperature and dewpoint at 1200 GMT November 15, 2000 at Washington D.C. plotted on a Skew-T diagram. The profiles from the surface to 700 mb show typical features of cold air outbreak stratocumulus: dry adiabatic lapse rate downward from the base of a substantial subsidence inversion at 800 mb.

TRANSITIONS

The COBEL Model is part of the FAA SFO Marine Stratus Nowcast System which is being demonstrated and evaluated during this summer (May to October 2001) for forecasting summer marine stratus burnoff in the Bay area.

RELATED PROJECTS

FAA SFO Marine Stratus Nowcast System mentioned in TRANSITIONS. The development of a hybrid RUC/COBEL forecast system is being planned at part of the FAA National Ceiling and Visibility Initiative that is just getting underway this fiscal (2001) year. The Nowcast for the Next Generation Navy project at NRL (http://www.nrlmry.navy.mil/~cook/nowcast/) is a closely related project.

SUMMARY

The development of a forecast system, which combines high quality forecasts of horizontal atmospheric motions from the Navy COAMPS mesoscale model with detailed calculations of processes in the first 3 kilometers of the atmosphere from the COBEL boundary layer model, will allow for better understanding of the interactions between the earth's surface and the atmosphere, including the processes responsible for the formation of low clouds and fog. This simulator of weather will be an extremely useful tool at the University for teaching students the physics of boundary layer processes and weather forecasting techniques for low clouds and fog.

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